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September 5, 2024

VIA ECFS

Marlene H. Dortch, Secretary
Office of the Secretary
Federal Communications Commission
445 12th Street, N.W.
Washington, DC 20554

**Re: NextNav Inc. Petition for Rulemaking
WT Docket No. 24-240; RM-11989**

Dear Ms. Dortch:

Enclosed are the comments of Avery Dennison Corporation, Impinj, Inc., r-pac International Corp., and Zebra Technologies Corporation regarding NextNav Inc.'s Petition for Rulemaking. Please contact the undersigned if there are any questions.

Respectfully submitted,

/s/ Tony S. Lee

Tony S. Lee

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.**

In the Matter of	)	
	)	
NextNav Inc. Petition for Rulemaking	)	WT Docket No. 24-240
	)	RM-11989
_____	)	

COMMENTS OF THE AD HOC RAIN RFID COALITION

Avery Dennison Corporation
Impinj, Inc.
r-pac International Corp.
Zebra Technologies Corporation

Date: September 5, 2024

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SUMMARY

The Ad Hoc RAIN RFID Coalition submits these comments in opposition to the Petition for Rulemaking filed by NextNav Inc. (“NextNav”). RAIN RFID is a passive UHF RFID technology operating in the 902-928 MHz band that is used to track inventory and relay information (“RAIN RFID Systems”) that is vital to daily operations and infrastructure in the United States. RAIN RFID technology is used throughout the country in various, disparate market segments, including health care operations, public safety infrastructure, national defense, and the national supply chain.

NextNav’s Petition proposes to reconfigure longstanding spectrum allocations in the 902–928 MHz band (“Lower 900 MHz Band”) that will have irrecoverable , harmful impacts on a significant number of existing uses and users. The U.S. government uses RAIN RFIDs for border security, tolling, drug and food safety, and military logistics, supply chain, and inventory control. Some states have issued enhanced driver’s licenses, or Real IDs incorporating RAIN RFID tags to more quickly access data and implement security measures. U.S. hospitals use RAIN RFID Systems to locate and manage equipment, medicines and medical devices.

All of the advancements and advantages made possible by RAIN RFID Systems would be significantly and adversely impacted by NextNav’s proposal to relocate existing incumbent operations to other frequencies, and to increase the power of its emissions into the Lower 900 MHz Band. NextNav’s petition should be rejected.

First, NextNav’s proposal would disrupt and degrade RAIN RFID Systems, deployed by federal, state and local governments and other operations that rely on RAIN RFID technology. Federal and state government uses include expedited northern and southern border crossings, the management and tracking of commercial goods, and the processing of security and data made possible through enhanced documents issued by certain states. RAIN RFID Systems are also used in a wide range of information and data gathering environments, including schools that use RFID devices in student identification cards for attendance and truancy purposes; hospitals that use RAIN RFID in patient wristbands to monitor patient recovery and speed administrative tasks; and employers that use RAIN RFID tags in identification cards, key fobs, and other devices to oversee employee resources and make decisions about how best to allocate resources and manage personnel and office space. These are just a few examples of the types of uses and services that NextNav’s reconfiguration would negatively impact.

Second, NextNav’s proposed reconfiguration would cause significant and costly disruptions to all RAIN RFID Systems. There are literally hundreds of millions of Part 15 devices, and billions of RAIN RFID tags that are in use today that would be negatively impacted by NextNav’s proposals. NextNav has not quantified the cost of its proposal on incumbents or the U.S. economy. If NextNav were permitted to implement its proposed reconfiguration plan, and it should not, NextNav should be required, at a minimum, to bear all incumbent relocation costs, which would likely be in the hundreds of billions of dollars. This, however, is only the direct costs of NextNav’s proposal, and does not factor in indirect costs caused by disruptions to the U.S. economy and infrastructure.

Third, there is simply no need for NextNav’s proposals as next generation wireless networks provide centimeter-level position accuracy that is significantly better than NextNav’s proposal without relying on the GPS satellite network. In addition, existing fiber networks can and do already provide terrestrial-based precision timing functionality. NextNav has not offered or provided any evidence that its implementation of a terrestrial-based positioning, navigation, and timing system would be any more resistant to signal jamming technologies than the current satellite system or alternative, existing terrestrial positioning, navigation, and timing (“PNT”) solutions.

Fourth, NextNav’s Petition will only benefit one entity – NextNav – at the expense of thousands of government agencies, public safety operations, and businesses of all sizes. The Petition is nothing more than a spectrum grab that will result in a massive windfall to NextNav. NextNav’s proposed reconfiguration will provide it with exclusive, nationwide spectrum rights that NextNav intends to lease to the highest bidder. Given that NextNav apparently intends to use its excess capacity to deploy 5G services, the Commission should, at minimum, require NextNav to submit its analysis of the cost of establishing the PNT network versus the value of the spectrum it seeks so the windfall to NextNav can be quantified. Further, to ensure that NextNav does not underinvest or even fail to develop its PNT network, the Commission should require NextNav to meet PNT deployment or service benchmarks before it can utilize its excess capacity for 5G or other services unrelated to the PNT network.

The Commission should reject the Petition. If it does not, the Commission should require NextNav to cover all costs for affected incumbents, and adequately protect and accommodate existing Part 15 devices, including all RAIN RFID Systems.

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COMMENTS OF THE AD HOC RAIN RFID COALITION

This *ad hoc* RAIN RFID¹ coalition, comprised of Avery Dennison Corporation, Impinj, Inc., r-pac International Corp., and Zebra Technologies Corporation, (together, the “Coalition”) hereby submits its comments regarding the Petition for Rulemaking filed by NextNav Inc. (“NextNav”) with the Federal Communications Commission (“Commission”) on April 16, 2024, and supplemented on June 6, 2024.²

I. INTRODUCTION

In its Petition, NextNav proposes to change longstanding spectrum allocations in the 902–928 MHz band (“Lower 900 MHz Band”) that will have irrecoverable, harmful impacts on a significant number of existing uses and users that are the very lifeblood of the U.S. public safety network, government operations, and the economy. RAIN RFID technology is deeply embedded in all aspects of daily life in the nation, including, among others:

¹ RAIN RFID is a passive, battery-free, wireless ultra-high frequency (“UHF”) Radio Frequency Identification (“RFID”) technology operating in the 902 – 928 MHz frequency band, utilizing a single, global standard (UHF Gen 2 (ISO/IEC 18000-63).

² NextNav Petition for Rulemaking, Enabling Next-Generation Terrestrial Positioning, Navigation, and Timing and 5G: A Plan for the Lower 900 MHz Band (902-928 MHz), WT Docket No. 24-240, RM-11989 (filed Apr. 16, 2024) (“Petition”). NextNav also filed a supplement proposing specific part 90 rule revisions. Letter from Robert Lantz, General Counsel, NextNav Inc., to Marlene H. Dortch, Secretary, FCC, WT Docket No. 24-240, RM-11989 (filed June 7, 2024) (“Petition Supplement”).

- Healthcare operations – such as the tracking of medicines and medical supplies;
- Public Safety Infrastructure – such as highway tolling systems and the tracking of food origination to protect public health;
- National Defense – RAIN RFID is used by the armed forces for logistics, tracking, and inventory control; and
- National Supply Chain – RAIN RFID is used by large enterprises for their internal operations, and by retailers for inventory and self-checkout.

NextNav’s proposed spectrum reconfiguration would have severe, adverse impacts on Part 15 devices in the Lower 900 MHz Band, including those that use RAIN RFID technology. There are more than 200 billion RAIN RFID tags and devices in use today, and RAIN RFID tag chip shipments are projected to reach 115 billion units annually by 2028.³ Given the ubiquity of RAIN RFID technology used in the U.S., the importance of protecting vital RAIN RFID use cases is even more heightened. The far-reaching, adverse consequences of NextNav’s proposals cannot be understated, and the Petition is nothing more than an attempt at a spectrum grab to enrich NextNav’s bottom line at the expense of the greater public good. Accordingly, the Coalition strongly urges the Commission to reject the Petition.

³ RAIN Alliance, *RAIN RFID Tag Chip Shipments Forecast to Reach 115bn Units by 2028, a Year-On-Year Growth of 20.4%*. <https://rainrfid.org/rain-rfid-tag-chip-shipments-forecast-to-reach-115bn-units-by-2028-a-year-on-year-growth-of-20-4/> (last viewed Sept. 3, 2024).

II. BACKGROUND

A. Coalition Members

The Coalition, collectively and individually, deploy Part 15 radio devices that operate in Lower 900 MHz Band to wirelessly connect everyday items to the internet (“RAIN RFID Systems”).⁴ A brief description of each of the Coalition members follows below:

- Avery Dennison Corporation (“Avery Dennison”) (NYSE: AVY), is a global materials science and digital identification solutions company headquartered in Mentor, Ohio.
- Impinj Inc. (“Impinj”) (NASDAQ: PI), is a global technology company providing a RAIN platform to deliver timely data about everyday things to businesses and consumers, and is headquartered in Seattle, Washington.
- r-pac international (“r-pac”), is a global provider of supplies, brand concepts, graphics, RFID, and products and solutions to partners in the retail supply chain utilizing RFID and other identification-based sensors, based in New York, New York.
- Zebra Technology Corporation (“Zebra”) (NASDAQ: ZBRA), is a global leader providing Enterprise Asset Intelligence (“EAI”) solutions to the Automatic Information and Data Capture (“AIDC”) industry, based in Lincolnshire, Illinois.

B. RAIN RFID

RAIN RFID Systems are primarily comprised of two types of radio-link devices: RAIN RFID readers, such as mobile handheld readers and fixed-overhead readers, and RAIN RFID endpoint labels, which receive energy and commands from the RAIN RFID reader devices and

⁴ See *In the Matter of Amendment of Parts 2 and 15 of the Commission’s Rules to Deregulate the Equipment Authorization Requirements for Digital Devices, Second Report and Order and Memorandum Opinion and Order*, 18 FCC Rcd 14741 (2003). In May 2005, the Commission issued public guidance based on that order specifically allowing RFID operation in the 902–928 MHz band under Part 15 of the Commission’s rules. See https://transition.fcc.gov/oet/ea/presentations/files/may05/New_Policies_Pt._15_SD.pdf (last viewed Sept. 3, 2024). The RAIN RFID industry has relied on the Commission’s order and guidance in deploying hundreds of millions of RFID tags and devices in a variety of disparate markets and industries.

reflect back a radio signal with the serialized barcode information programmed onto the label. The RAIN RFID industry has delivered tens of millions of RAIN RFID readers and tens of billions of tags, delivering use cases that benefit the public in myriad ways. RAIN RFID labels are attached or integrated into everyday items such as apparel inventory, medical supplies, package labels, and auto parts, that can then be uniquely identified and located wirelessly via serialized barcodes. The end users of RAIN RFID include many of the largest U.S. retailers for inventory management, U.S. supply chain companies for tracking packages, U.S. healthcare providers for tracking medical supplies, and U.S. government agencies for official IDs and highway tolling systems, among other uses.

C. NextNav Petition for Rulemaking

In its Petition, NextNav asks the Commission to reconfigure the Lower 900 MHz Band and adopt new rules to enable NextNav to deploy a proprietary positioning, navigation, and timing (“PNT”) network that it asserts is needed to complement and back up existing the U.S. Global Positioning System. NextNav also asks that the Commission reconfigure the Lower 900 MHz Band by creating a 5-megahertz uplink in the 902-907 MHz band paired with a 10-megahertz downlink in the 918-928 MHz band so it can provide, or license the spectrum to others, to provide two-way 5G voice and data services so NextNav can afford to build its PNT network.⁵

⁵ In the Petition, NextNav asserts that “despite the compelling need for robust terrestrial PNT services ... it is not economically feasible to deploy a widescale, standalone terrestrial PNT network.” Petition at ii. *See also* NextNav, Inc., Annual Report (Form 10-K) (Mar. 13, 2024) at 23 (“One of the significant benefits of converting our spectrum transmissions, including those with respect to spectrum we are seeking to acquire pursuant to the Asset Purchase Agreement dated March 7, 2024 [with Telesaurus Holdings GB and Skybridge Spectrum Foundation], to a 5G NR platform would be a substantial increase in the data transmission capacity of our network, thus facilitating the carriage of non-PNT-related two-way voice and data services alongside our core PNT data transmission.”)

The Petition is the latest NextNav gambit to yield shareholder value by securing valuable spectrum from the Commission. In 2014, the Commission decided against adopting a related NextNav petition⁶ (then through its wholly owned subsidiary, Progeny LMS, LLC) requesting, among other things, a new band plan.⁷ The Commission terminated the proceeding initiated largely due to Progeny’s petition because rule changes were deemed unnecessary in light of the limited rule waiver granted to Progeny.⁸ In this latest effort, NextNav appears to have spent \$50 million for, *inter alia*, spectrum licenses to increase its spectrum holdings to advance a plan to petition the Commission for rule changes to benefit its spectrum holdings portfolio.⁹

On August 6, 2024, the Commission’s Wireless Telecommunications Bureau (“WTB”) and the Office of Engineering and Technology (“OET”) issued a public notice (“Public Notice”) requesting comments on all aspects of NextNav’s petition, including (i) the identification and protection of incumbents, (ii) the extent of Part 15 devices use of the Lower 900 MHz Band, (iii) what services are provided by Part 15 devices in the Lower 900 MHz Band, (iv) the impact of NextNav’s “flexible use” rules allowing more power in the Lower 900 MHz Band, (v) whether Part 15 devices can be accommodated in another band and, if so, the cost and time such relocation may take, (vi) the costs and benefits of the proposal that the Commission designate

⁶ Progeny LMS, LLC, Petition for Rulemaking, WT Docket No. 06-49, (filed Mar. 5, 2002).

⁷ *In the Matter of Amendment of the Commission’s Part 90 Rules in the 904-909.75 and 919.75-928 MHz Bands*, Order, 29 FCC Rcd 6361 (2014).

⁸ *Id.* at 6365, ¶ 8.

⁹ See NextNav, Inc., Annual Report (Form 10-K) (Mar. 13, 2024) at F-30 (available at <https://www.sec.gov/ix?doc=/Archives/edgar/data/1865631/000121390024022183/nm-20231231.htm> (last viewed Sept. 3, 2024)); see also Petition at n.2.

NextNav as the nationwide licensee with rights to lease almost 10 megahertz of spectrum, and (vii) the windfall that NextNav would receive as a result of the reconfiguration.¹⁰

III. DISCUSSION

A. NextNav's Proposed Reconfiguration Will Cause Significant Harm to the Public.

The 900 MHz band has traditionally been used by RAIN RFID, LoRa, and other technologies worldwide, and approval of the Petition would severely inhibit the use of such technologies, negatively impacting and severely crippling supply chains globally with major financial and commercial repercussions. Moreover, if adopted, the proposed changes will have profound negative impacts on RAIN RFID deployments in the U.S., effectively destroying the resilience and efficiency of America's supply chains, businesses, and government agencies. The rippling effect would have dire global consequences across globally interconnected supply chains, affecting world economies, manufacturing, and commerce.

By hindering the use of RAIN RFID and other Part 15 devices in the U.S., the Commission would essentially be destroying the highly evolved and integrated global multi-billion dollar ecosystem of RAIN RFID manufacturers, suppliers, service providers, and customers which include many of the Fortune 100, public safety, military and emergency responders which have invested over hundreds of millions of dollars in cost-savings and operational efficiencies resulting in improved global supply chain visibility, shareholder value, and investor returns for more than two decades.

¹⁰ *Wireless Telecommunications Bureau and Office of Engineering and Technology Seek Comment on NextNav Petition for Rulemaking*, Public Notice, DA 24-776, at 2, 4 ("Public Notice").

As further detailed below, a wide variety of key end users of RAIN RFID Systems and the critical services they provide throughout the U.S. will be negatively impacted if NextNav's proposed reconfiguration is allowed to proceed. Furthermore, as a technical matter, NextNav's proposed spectrum reconfiguration currently used by those RAIN RFID Systems is unfeasible, the costs of effecting such a reconfiguration would be enormous.

1. NextNav's Proposed Reconfiguration Will Directly, Adversely Impact the National Safety and Security of the United States.

Congress has charged the Commission with promoting a "Nation-wide, and world-wide wire and radio communications service" for the purposes of the "national defense" and preserving the "safety of life and property."¹¹ To that end, the Commission has taken appropriate steps in other proceedings to protect national security and public safety.¹² NextNav's proposal threatens to severely undermine national defense initiatives and disrupt important public safety operations. Relevant to the instant proceeding, several U.S. federal and state governmental agencies currently use RAIN RFID Systems in the services they provide to the public and in the interest of national safety and security, and those uses are expanding. See Table 1 below.

¹¹ 47 U.S.C. § 151.

¹² See, e.g., *Protecting Against National Security Threats to the Communications Supply Chain Through FCC Programs*, Report and Order, Further Notice of Proposed Rulemaking, and Order, 34 FCC Rcd 11423 (2019) (prohibiting the use of USF funds to obtain certain communications equipment that poses a threat to national security).

Table 1. Governmental use of RAIN RFID Systems for safety and security¹³

Department	Agency	Usage	Description / References
Department of Homeland Security (DHS) and Department of State	CBP	Border control	Western Hemisphere Travel Initiative , Trusted Traveler Programs (SENTRI , NEXUS , and FAST), Global Entry, Real ID , Enhanced Drivers License from state agencies
	TSA	Airport security	
Department of Transportation (DOT)	FHWA	Tolling	See 23 C.F.R. § 950.1 requiring electronic toll interoperability
	FAA	Airplane parts tracking	Airworthiness Approval of Installed Radio Frequency Identification (RFID) Tags and Sensors
Health and Human Services (HHS)	FDA	Drug safety and security*	Drug Supply Chain Security Act
		Food safety and traceability*	Food Safety Modernization Act (FSMA)
Agriculture (USDA)	APHIS	Livestock tracking	APHIS Bolsters Animal Disease Traceability in the United States
Department of Defense (DOD)	DLA, USMC , Navy , Army and Air Force	Logistics and supply chain	DoD Suppliers' Passive RFID Information Guide
		Inventory control	

*proposed

Any disruption to or degradation of the RAIN RFID Systems deployed by these federal government users will directly, adversely impact U.S. national safety and security interests at home and abroad. For example, the U.S. Customs and Border Patrol (“CPB”) has established “Ready Lanes” for those entering the United States through a land border port of entry on the northern or southern borders using an RFID enabled document.¹⁴ Ready Lanes are dedicated processing lanes for both vehicle passengers and pedestrians traveling with Ready Lane-eligible travel cards, including U.S. Passport Cards, Enhanced Driver’s Licenses, Enhanced Tribal Cards, Enhanced Border Crossing Cards, Enhanced Permanent Resident Cards, and Trusted Traveler

¹³ Table 1 contains links that can be used to access more information on each of these systems.

¹⁴ U.S. Customs and Border Patrol, *Ready Lanes*, <https://www.cbp.gov/travel/clearing-cbp/ready-lanes> (last viewed Sept. 3, 2024).

Program (NEXUS, SENTRI, Global Entry, or FAST) cards.¹⁵ These programs support expedited US border crossings and enable participants to use expedited fast lanes for travel. According to a U.S. Government Accountability Office Congressional Report, in 2022, CBP processed over 44 million entries into the United States via the Trusted Traveler Program.¹⁶ If the NextNav proposals were implemented, these programs would be rendered useless, significantly backing up U.S. land border crossing traffic and adversely impacting travel and commerce.

Similarly, the Department of Homeland Security (“DHS”), CBP Automated Commercial Environment (“ACE”) Modernization effort are two separate modernization initiatives that include (1) a new user interface to streamline all ACE business processes to track, monitor, manage and process commercial goods; and (2) enhanced truck manifest functionality to assist the trade community and CBP officers during truck processing at U.S. ports of entry.¹⁷ The ACE system integrates information from multiple scanning and imaging technologies to provide CBP officers with cargo, trip, driver, and vehicle details, and enable CBP officers to make data-driven vetting decisions in real-time.

¹⁵ *Id.* The CPB programs that issue Trusted Travelers RFID-enabled credentials are Global Entry, NEXUS, SENTRI, and FAST. See U.S. Customs and Border Patrol, <https://www.cbp.gov/travel/trusted-traveler-programs> (last viewed Sep. 3, 2024).

¹⁶ U.S. Government Accountability Office, Report to Congressional Committees, *DHS Has Enrollment Processes, but CBP Should Provide Additional Information on Reconsiderations*, at 7, <https://www.gao.gov/assets/870/868339.pdf> (last viewed Sept. 3, 2024).

¹⁷ U.S. Department of Homeland Security, *Privacy Impact Assessment Update for the Automated Commercial Environment (ACE) Modernization*, https://www.dhs.gov/sites/default/files/2023-09/23_0926_privacy-p%E2%81%AEia-cbp003c-acemodernizations.pdf (“ACE Privacy Impact Assessment Update”) (last viewed Sept. 3, 2024). RFID tags used in the ACE system operate in the 915 MHz frequency band, *Electronic Security System for Monitoring and Recording Activity and Data Relating to Cargo*, Patent No. 7,012,529, at 10 <https://patentcenter.uspto.gov/applications/10871263> (last viewed Sept. 3, 2024).

In furtherance of its goal to expedite border crossings, CBP also developed a mobile application called “CBP Truck QR.”

Use of the CBP Truck QR application is voluntary and speeds processing during inspection by allowing the trade community to produce a Quick Response (QR) code or otherwise code the reprogrammable memory in the Decal and Transponder Online Procurement System (DTOPS) radio-frequency identification (RFID) tag with the ACE trip number, estimated date of arrival, and license plate data of the truck. The QR Code or RFID coding can then be read at the port upon truck arrival to identify the ACE trip.¹⁸

The DHS and CPB’s ACE and CBP Truck QR programs have improved the efficiency of the movement of shipments, streamlined the identification of potential issues early in the supply chain, and enabled faster resolution of potential administrative issues. These and other benefits would be adversely affected by harmful interference if NextNav’s proposals were adopted.

The adverse impact of NextNav’s rule changes would also affect the public at large and not just at the U.S. borders. Led by the Department of Homeland Security, by May 7, 2025, all U.S. citizens will require an enhanced ID, or Real ID, to fly domestically or visit a federal facility.¹⁹ Some states are issuing enhanced IDs containing RFID chips that can be used to communicate security information.²⁰ Several states and other federal agencies have already deployed the RAIN RFID Systems and corresponding infrastructure necessary for seamless management. If those RAIN RFID Systems experience disruption or interference, or require replacement as a result of NextNav’s proposal, this would significantly harm the U.S.’s ability to

¹⁸ ACE Privacy Impact Assessment, at 4.

¹⁹ U.S. Transportation Security Administration, *REAL ID “Your ‘Ready for Takeoff’ Self”* <https://www.tsa.gov/videos/real-id-your-ready-takeoff-self#:~:text=Beginning%20May%207%2C%202025%2C%20every,fly%20within%20the%20United%20States> (last viewed Sept. 3, 2024).

²⁰ U.S. Department of Homeland Security, *Benefits of an EDL*, <https://www.dhs.gov/enhanced-drivers-licenses-what-are-they> (last viewed Sept. 3, 2024).

implement and deploy security protocols through the RFID technology incorporated into enhanced credentials.

In addition to U.S. federal and state users of RAIN RFID Systems, local government and commercial users would also be adversely affected. RAIN RFID Systems are used for a wide range of information and tracking scenarios that would be disrupted at great cost to those using them if NextNav's petition is granted. School districts, for example, use RFID devices in student identification cards to track attendance and address truancy with greater accuracy and efficiency.²¹ Hospitals use RFIDs in patient wristbands to monitor patient recovery and speed administrative tasks such as registration and accessing medical history.²² Employers use RFID devices contained in identification cards, key fobs, and other devices to oversee employee resources and make decisions about how best to allocate resources and manage personnel and office space.²³ Several U.S. hospital systems and other healthcare providers, such as Sloan Kettering Cancer Center and the Mayo Clinic, use Part 15 devices to improve the ability to locate and manage medicines and medical devices.²⁴ Furthermore, RAIN RFID Systems were used

²¹ Engineerica, *Attendance Tracking with RFID Technology*, <https://www.engineerica.com/attendance-tracking-rfid/> (last viewed Sep. 3, 2024).

²² RAIN Alliance, *Evolving Healthcare: The Transformative Impact of RFID in Patient Tracking*, <https://rainrfid.org/rfid-healthcare-patient-tracking/> (last viewed Sep. 3, 2024).

²³ HID Global, *Time and Attendance*, <https://www.hidglobal.com/solutions/time-and-attendance> (last viewed Sep. 3, 2024).

²⁴ See *Integrating the RFID and Infusion Pump Systems at Memorial Sloan-Kettering Cancer Center*, <https://www.ecri.org/components/HDJournal/Pages/hd-award-yr-7-msk.aspx?tab=1> (last viewed Sept. 3, 2024); *Memorial Sloan Kettering Cancer Center Improves Supply Chain with RFID*, <https://www.rfidjournal.com/video/memorial-sloan-kettering-cancer-center-improves-supply-chain-with-rfid/56759/> (last viewed Sept. 3, 2024); Tracy Will, *Mayo Clinic Laboratories Uses Enhanced Technology to Safeguard Patient Specimens*, <https://newsnetwork.mayoclinic.org/discussion/mayo-clinic-laboratories-uses-enhanced-technology-to-safeguard-patient-specimens/> (last viewed Sept. 3, 2024).

throughout the COVID-19 pandemic to track vaccines and personal protective equipment.²⁵

Delay or disruption in the RAIN RFID Systems deployed by these users would directly, adversely impact the delivery of healthcare services throughout the U.S., particular when fast, reliable inventory and data tracking is literally the difference between life and death in emergency or critical situations. The interference from NextNav’s proposed reconfiguration and operations in the Lower 900 MHz Band threatens the ability of healthcare providers, teachers, and many other stakeholders to efficiently and effectively gather information essential to their operations.

The Commission should reject the Petition to avoid negatively impacting these critical U.S. interests. At a minimum, the Commission should require that NextNav produce a detailed study of the cost- and time-burden that NextNav’s proposed reconfiguration would impose on each U.S. federal and state agency currently deploying RAIN RFID Systems. See Section III.A.3 below for further discussion on the cost of disruption.

2. NextNav’s Proposed Reconfiguration Will Cause Significant and Costly Disruption to All RAIN RFID Systems.

As the Commission notes in the Public Notice, the Petition “is unclear regarding the extent to which the proposed reconfiguration would impact potentially millions of such [Part 15] devices.”²⁶ The reason that NextNav did not include that information in its Petition is because

²⁵ *Kit Check RFID Helps Reading Hospital with its COVID-19 Vaccine Roll Out*, <https://bluesight.com/blog/kit-check-rfid-helps-reading-hospital-with-its-covid-19-vaccine-roll-out/> (last viewed Sept. 3, 2024); RAIN Alliance, *GD Medical Fast-Tracks Deployment of Medical Supplies for US Healthcare with Xerafy RFID*, <https://rainrfid.org/gd-medical-fast-tracks-deployment-of-medical-supplies-for-us-healthcare-with-xerafy-rfid/> (last viewed Sept. 3, 2024).

²⁶ Public Notice at 4.

the impact to Part 15 devices, including RAIN RFID Systems, will be extensive, unavoidable, and inestimable.

NextNav's proposed reconfiguration will result in interference with existing RAIN RFID Systems and prevent these systems from functioning properly, causing irreversible harm to use cases beyond those discussed in Section III.A.1, *supra*. According to the RAIN Alliance, about 80 billion items have now been tagged with RAIN RFID in the United States alone, across all sectors including healthcare, retail, supply chain, food, aviation, automotive, and sporting events.²⁷ Almost all market sectors would be negatively impacted, preventing the real-time tracking, traceability, and visibility of assets. This would, in turn, result in devastating losses in productivity worldwide.

NextNav also proposes to transmit much higher power into the Lower 900 MHz Band, which will effectively crowd out any other devices working at lower power by creating too much interference in the Lower 900 MHz Band. The 30-day deadline set in the Public Notice for interested parties to submit comments in response to the Petition did not provide sufficient time for the Coalition to conduct an in-depth or detailed analysis of the technical information submitted by NextNav. Nonetheless, the Coalition and RAIN Alliance members performed a preliminary technical interference analysis of NextNav's proposal, which shows that NextNav base stations and RAIN readers need at least several kilometers of separation.²⁸ The interference analysis uses typical (not worst case) RAIN reader characteristics, and thus, separation distances

²⁷ RAIN Alliance, *Defending RFID Supply Chain Resilience in the United States: The Power of Community*, <https://rainrfid.org/defending-rfid-supply-chain-resilience-in-the-united-states-the-power-of-community/> (last viewed Sept. 3, 2024).

²⁸ See Exhibit A, attached hereto. See also Aileen Ryan, Alliance President and CEO, *Quantifying the Impact of the NextNav Rulemaking Petition*, <https://rainrfid.org/quantifying-the-impact-of-the-nextnav-rule-making-petition/> (last viewed Sept. 3, 2024).

could be even farther if a more conservative approach were used. In addition, the preliminary analysis only reviews two out of many mechanisms of potential interference between NextNav and RAIN systems. The preliminary analysis is certainly not exhaustive, but it substantiates RAIN users' and vendors' concerns that NextNav's proposal would cause harmful interference to RAIN RFID Systems.

Before taking any further action on the Petition, the Commission must solicit additional information, data, and analysis from interested parties so that NextNav's proposal and technical information can be fully vetted, and the adverse impact on RAIN RFID Systems and other incumbents in the Lower 900 MHz Band can be determined, before moving forward. The preliminary analysis in Exhibit A strongly suggests that every RAIN RFID System will be potentially impacted by NextNav's increased power, and the increased "noise" will mean that RAIN RFID readers will be unable to (or will be unable to reliably) communicate with the RAIN RFID labels that are attached to the items that end users seek to identify and locate. In practical terms, this could result in, for example, a CPB officer being unable to verify a Trusted Traveler credential, or result in the shipment of an inaccurate quantity of medicines or vaccines due to NextNav increased transmission power and harmful interference.

Rather than offering any protection or accommodation for Part 15 devices, NextNav has specifically requested that its devices be permitted the right to interfere with any existing Part 15 device, including any RAIN RFID System²⁹ and the removal of the safe-harbor protection for Part 15 device operation.³⁰ Because of Part 15 devices are unlicensed by nature, NextNav has no ability to identify (let alone protect, accommodate or migrate) the impacted incumbents or end

²⁹ Petition Supplement at A-11 (proposing to add § 90.1410(c)).

³⁰ Petition Supplement at A-6 (proposing to amend § 90.361).

users. Unlicensed Part 15 devices number in the *hundreds of millions*.³¹ In addition, RAIN RFID labels number in the *hundreds of billions*.³²

Moreover, even assuming NextNav were somehow able to identify all of the Part 15 devices, given number and wide dispersion of Part 15 devices, it would not be possible to geographically separate or segregate the spectrum uses. That is, even if NextNav were to limit its transmissions to work only outside a defined radius from a specific geographic location, this would not solve the interference with potentially hundreds of millions of other use cases. Lastly, it is important to note that any migration of RAIN RFID Systems outside of the Lower 900 MHz Band would require a full hardware replacement since the antennas and RF filters in the equipment are limited to the Lower 900 MHz Band. In other contexts, the Commission required the relocation costs for incumbent operations to be paid for by newcomers to the spectrum.³³ NextNav makes no attempt to quantify what its relocation cost reimbursement obligations might be, and those amounts could literally be in the hundreds of billions of dollars.

The Commission should properly view NextNav’s statement that it will “work with unlicensed users”³⁴ as disingenuous. NextNav is aware of the limitations above and has not offered any potential solution because it has none. For these reasons, the Commission should

³¹ This number covers all Part 15 devices, including smart metering and tolling. See Consumer Technology Association, *Unlicensed Spectrum and the U.S. Economy – Quantifying the Market Size and Diversity of Unlicensed Devices* (Jan. 2022) <https://docs.house.gov/meetings/IF/IF16/20230310/115463/HHRG-118-IF16-20230310-SD006.pdf> (last viewed Sept. 3, 2024). Of this number, RAIN RFID readers represent only approximately 4.5 million. See *RAIN RFID 2024 Market Report*, <https://rainrfid.org/rain-rfid-2024-market-report/> (last viewed Sept. 3, 2024).

³² See n.27, *supra*.

³³ See, e.g., *Improving Public Safety Communications in the 800 MHz Band*, Report and Order, Fifth Report and Order, Fourth Memorandum Opinion and Order, and Order, 19 FCC Rcd 14969 at ¶ 33 (2004).

³⁴ Petition at 31.

reject the Petition. At a minimum, the Commission should require NextNav to produce a detailed study of the technical and economic impact of its interference with Part 15 devices.

3. The Direct and Indirect Costs of NextNav's Proposed Reconfiguration Will be Enormous.

The Commission must take into account a myriad of direct and indirect costs that will be necessitated by NextNav's proposed reconfiguration. The Coalition estimates that, accounting for RAIN RFID Systems alone (not including other Part 15 and Part 90 devices), current sellers, implementers and end users of RAIN RFID Systems will need to expend billions of dollars to replace existing solutions if the NextNav proposed reconfiguration is approved. This is only the direct cost of replacing the hardware units that are currently deployed.

Beyond the direct cost of hardware replacement, the sellers, implementers, and end users of RAIN RFID Systems will also be forced to invest significant resources (e.g., research and development) to take into account the NextNav proposed reconfiguration and modify their devices and systems to work in or around NextNav's high-power spectrum use. This sunk opportunity and productivity loss is immense and unmeasurable. For example, every hour and dollar the Department of Defense spends on redeploying a RAIN RFID System is an hour and dollar not spent on other national security priorities.

Ultimately, the general public will bear significant costs as a result of NextNav's proposed reconfiguration. While NextNav may offer or be required to compensate incumbents, there are significant end user costs that will be unavoidable. This may occur either through increased costs of services that today rely on RAIN RFID Systems, or less directly through lost time and productivity. For example, even if NextNav were to compensate the U.S. government (and taxpayers) for the TSA's cost of redeploying the Truster Traveler and Real ID programs ,

the time spent by each individual to replace their document is unavoidable, unmeasurable, and a drain on economic productivity at a massive scale.

For the reasons above, the Commission should reject the Petition and avoid imposing these direct and indirect costs on the incumbents to the Part 15 unlicensed band, including the users of RAIN RFID Systems, and the general public more broadly. As discussed above, at a minimum, the Commission should require NextNav to provide detailed economic studies assessing the direct and indirect impacts of NextNav's proposed reconfiguration, allow time for the Commission and interested stakeholders to assess those economic impacts, and ensure that NextNav is adequately compensating all stakeholders and the general public if the proposed reconfiguration were to move forward.

4. NextNav's Proposed Reconfiguration Will Hinder U.S. Economic Interests in Innovation and Leadership.

The Commission has been the global leader in allocating the unlicensed Lower 900 MHz Band for use with RFID. The Coalition and many other U.S. sellers, integrators and end users of RAIN RFID Systems have benefited from the Commission's leadership by developing products, solutions and services that are easily deployed on a global scale. Now, the Commission's approval of the NextNav petition would alter the usage of the Lower 900 MHz Band, desynchronizing the U.S. with the rest of the world. This will put all U.S. companies and U.S. end users at a disadvantage in the global market. Moreover, the unlicensed Lower 900 MHz Band has been a fertile ground for U.S. innovation over the past two decades, as it acts as a protected sandbox for nascent wireless technologies to deploy at low cost. Eliminating or reducing that sandbox will stifle future innovation.

B. NextNav’s Proposed Reconfiguration Will Only Benefit NextNav.

NextNav’s proposed reconfiguration is not necessary or appropriate to achieve a terrestrial PNT system as a technical matter. Rather, while NextNav shrouds its Petition in the “national interest,” it is little more than a transparent attempt to secure valuable low-band 5G spectrum to benefit its investors at the expense of the general public.

1. NextNav’s Proposed Reconfiguration is Unnecessary and Does not Provide Benefits Commensurate with its Costs.

NextNav argues that its proposed reconfiguration is necessary to enable its PNT service to fill a national security need – a redundant terrestrial positioning service that does not rely on satellite technology.³⁵ However, the next generation mobile phone standard, specifically 5G NR Release 18, supports “carrier phase positioning,” which implements centimeter-level positioning accuracy that is much better than the meter-level positioning accuracy proposed by NextNav.³⁶ NextNav also argues that its proposed reconfiguration is necessary to enable its PNT service to fill a national security need – a redundant precision timing system that does not rely on satellite technology.³⁷ However, existing fiber network backhauls for mobile phone base stations already provide timing functionality, and recent fiber networking standards provide sub-nanosecond timing accuracy that is vastly superior to the timing accuracy of tens of nanoseconds proposed by

³⁵ Petition at i.

³⁶ A. Fouda, R. Keating and H. -S. Cha, “Toward cm-Level Accuracy: Carrier Phase Positioning for IIoT in 5G-Advanced NR Networks” <https://ieeexplore.ieee.org/document/9977723> (last viewed Sept. 3, 2024); 3GPP 5G NR Release 18, August 2024, https://www.etsi.org/deliver/etsi_ts/138100_138199/13810101/18.06.00_60/ts_13810101v180600p.pdf (last viewed, Sept. 3, 2024).

³⁷ Petition at i.

NextNav.³⁸ Lastly, while NextNav suggests its private PNT service is necessary as a matter of national security, NextNav has not offered or provided any evidence that its implementation of a terrestrial-based PNT system would be any more resistant to signal jamming technologies than the current satellite system or alternative, existing terrestrial PNT solutions. Indeed, NextNav's proposed reconfiguration would result in one singular provider of the terrestrial-based PNT service, which in itself would present a national security risk, for example, if that singular provider fails or experiences a cybersecurity incident.

Accordingly, the Commission must view any terrestrial PNT need as entirely possible without changing the spectrum band configuration and the Part 15 rules. Rather, the Commission could achieve a terrestrial PNT through existing and must less costly means, such as incentives or mandates for existing carriers and providers to include terrestrial PNT. The approach would avoid any disruption to the millions of existing incumbents, end users and general public. This approach would also benefit the market by enabling flexibility as to the PNT technology and provider available to deliver the solution, which will drive cost and performance efficiencies.

For these reasons, the Commission should reject the Petition. At a minimum, the Commission should require NextNav to address why its proposed reconfiguration is necessary in light of alternative, less disruptive PNT solutions, including input from the various existing carriers and providers that are able to provide those solutions.

³⁸ IEEE 1588-2019 standard, "IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems"; see review in F. Girela-López, J. López-Jiménez, M. Jiménez-López, R. Rodríguez, E. Ros and J. Díaz, *IEEE 1588 High Accuracy Default Profile: Applications and Challenges*, IEEE Access, vol. 8, pp. 45211-45220, 2020 (showing timing error below 0.1 nsec).

2. NextNav’s Proposed Reconfiguration is a Privatization of a Free Public Resource, Resulting in a Massive Windfall to NextNav Alone.

NextNav frames its Petition as being in the national interest, but even a cursory peek behind the NextNav curtain shows that at its core, the Petition is nothing more than a spectrum grab. If allowed, NextNav’s reconfiguration would result in a massive windfall to NextNav, effectively privatizing spectrum currently used for free by many millions of unlicensed users and devices, at minimal cost to NextNav but at massive cost and disruption to the public.³⁹ The primary and only true beneficiary will be NextNav and its investors.

Despite its assertions about national security, NextNav’s proposed reconfiguration will provide it with exclusive, nationwide spectrum rights that NextNav intends to lease to the highest bidder. NextNav has stated that as only two-to-five percent of the reconfigured spectrum would be used for a terrestrial PNT, NextNav would simply monetize the remaining spectrum by leasing it out to carry third party 5G broadband services.⁴⁰ Indeed, NextNav’s CEO fully admits that they “haven’t figured out yet” how NextNav’s 900 MHz spectrum will be put into use. If only two to five percent of the reconfigured spectrum would be used for terrestrial PNT, and NextNav has no concrete plans for the remaining 95 – 98% of its spectrum, it is clear that NextNav intends to engage in the hoarding of valuable spectrum with new privileges that it seeks

³⁹ The Communications Act requires the Commission to “prevent unjust enrichment as a result of the methods employed to issue licenses” *In the Matter of Updating Part 1 Competitive Bidding Rules*, Notice of Proposed Rulemaking, 29 FCC Rcd 12426 ¶ 4 (citing 47 U.S.C. § 309(j)(4)(E)).

⁴⁰ Mike Dano, *NextNav’s CEO Explains Her 5G Network Buildout Plan*, <https://www.lightreading.com/5g/nextnav-s-ceo-explains-her-5g-network-buildout-plan> (last viewed Sept. 3, 2024).

to obtain for free.⁴¹ The Commission has long had a policy against spectrum hoarding to ensure that frequency bands are distributed to those that will be able to put this scarce resource to best use.⁴²

Given that NextNav apparently intends to use its excess capacity to deploy 5G services, the Commission should, at minimum, require NextNav to submit its analysis of the cost of establishing the PNT network versus the value of the spectrum it seeks so the windfall to NextNav can be quantified. Further, to ensure that NextNav does not underinvest or even fail to develop its PNT network, the Commission should require NextNav to meet PNT deployment or service benchmarks before it can utilize its excess capacity for 5G or other services unrelated to the PNT network.

NextNav has existed since 2007 and, despite raising hundreds of millions in investor funding (including a recent SPAC IPO), its revenues are declining.⁴³ Together with its predecessor, NextNav has acquired Part 90 L-LMS spectrum and failed to successfully deploy it for 25 years. The current Petition is a desperate effort to get the Commission (and the users of the Lower 900 MHz Band) to provide life support to NextNav's failed financial plans.

For these reasons, the Commission should reject the Petition as contrary to principles of fairness and public benefit.

⁴¹ Section 309(j) of the Communications Act requires the Commission to award spectrum licenses through competitive bidding where mutually exclusive applications are accepted for filing. 47 U.S.C. § 309(j). The Commission has used auctions to award licenses like those sought by NextNav. *See, e.g., Auction of AWS-1 And Broadband PCS Licenses Rescheduled for August 13, 2008*, Public Notice, 23 FCC Rcd 7496 (2008); *Auction of 700 MHz Band Licenses Scheduled for January 24, 2008*, Public Notice, 22 FCC Rcd 18141 (2007).

⁴² *See, e.g., Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules*, First Report and Order, 15 FCC Rcd 476 (2000).

⁴³ Bleeker Street Research, *NextNav (NN): Geolocation Data Firm Navigating Into Choppy Waters*, <https://www.bleeckerstreetresearch.com/research/nn> (last viewed Sept 3, 2024).

C. Other Considerations

Lastly, while this comment is focused on RAIN RFID Systems, it is important to note that many (if not all) of the issues identified above are equally applicable to the plethora of other Part 15 and Part 90 NM-LMS devices that are currently operating in the Lower 900 MHz Band. These other incumbents are better positioned to address their particular situations, and the Coalition expects that they will submit comments in response to the Public Notice that address the more specific impacts on their own use of the Lower 900 MHz Band. The Coalition has identified at least the following additional key users and applications in the Lower 900 MHz Band that will be impacted by NextNav's proposed reconfiguration. See Table 2 below.

Table 2. Users and applications in the Lower 900MHz Band that use Part 90 NM-LMS or use technologies besides ISO 6C.

End User(s)	Utility companies (Rhode Island Energy, Seattle City Light, Austin Energy, etc.)	Vehicle operators	Airport security, (e.g. DIA) Agriculture (e.g. Cargill)	Railroad operators (CSX, BNSF, Union Pacific)	180 Tolling agencies (e.g. E-ZPass) in 35 states ⁴⁴
Application	AMI (advanced metering infrastructure, e.g. Electric utility smart meters)	Keyless Entry	Vehicle access control	Railcar tracking	Tolling
Federal agencies and Industry associations	American Public Power Association		FAA	US DOT	IBTTA, E-ZPass IAG, 6C Toll Operators
FCC Rules	Section 15.247	Section 15.249	Part 15 and Part 90 NM-LMS	Part 15 and Part 90 NM-LMS	Part 90 NM-LMS
Technology (standard)	Proprietary Mesh FHSS	Proprietary fixed frequency FSK	Gen2/6C	ATA	Gen2/6C and ASTMv6

⁴⁴ U.S. Department of Transportation, Federal Highway Administration, *Nationwide Electronic Toll Collection Interoperability*, Pub. No. FHWA-HOP-21-023 (March 2021), <https://ops.fhwa.dot.gov/publications/fhwahop21023/fhwahop21023.pdf> (last viewed Sept. 3, 2024).

The Coalition anticipates that stakeholders of tolling solutions (IBTTA, E-ZPass, 6C Coalition) will submit their own comments addressing that study and the impacts of the NextNav proposed reconfiguration.⁴⁵ NextNav, however, does not (and does not even purport to) address the impacts on the millions of other Part 15 and Part 90 NM-LMS non-tolling solutions of the Lower 900 MHz Band.

The Commission should not take any action on the Petition until the many stakeholders and interested parties have had an opportunity to provide specific comment. Indeed, in past proceedings similar to the instant case, the Commission has first solicited comments before issuing a formal notice of proposed rulemaking.⁴⁶ The Coalition is concerned that the Commission's short timing and process for requesting comment in the Public Notice, in particular the 30-day window – running the month of August and ending the week of a U.S. holiday – is inadequate for the multitude of disparate users of the Lower 900 MHz Band to digest the lengthy Petition and provide fully developed comments. The Commission must allow for the incumbents and interested stakeholders to analyze the Petition and prepare technical and economic studies.

Accordingly, the Commission should decline to take further action on the Petition and extend the time period for review, analysis, and public comment set forth in the Public Notice.

⁴⁵ See, IBTTA at <https://www.ibtta.org/about-us>, E-ZPass Group at <https://www.e-zpassag.com/about-us/overview>, and 6C Coalition at <http://6c-toc.com/node/8> (last viewed Sept. 3, 2024).

⁴⁶ See, e.g., *In the Matter of Amendment of the Commission's Part 90 Rules in the 904-909.75 and 919.75-928 MHz Bands*, Notice of Proposed Rulemaking, 21 FCC Rcd 2809 (2006) (notice of proposed rulemaking issued in response to Progeny's petition for rulemaking).

IV. CONCLUSION

In conclusion, the Coalition respectfully requests that the Commission reject the Petition. In the alternative, if the Commission is not prepared to fully reject the Petition at this stage, the Commission should require NextNav to adequately protect and accommodate existing Part 15 devices, including all RAIN RFID Systems. That will require NextNav to provide detailed analysis, including at least technical expert reports, economic analysis, and feasibility studies.

Respectfully submitted,

Avery Dennison Corporation
Impinj, Inc.
r-pac International Corp.
Zebra Technologies Corporation

Date: September 5, 2024

EXHIBIT A

**NextNav Base Station to
RAIN RFID Reader Preliminary Interference Analysis**

NextNav Basestation to RAIN Reader interference analysis

Item	Description	Adjust Factor (dB)	Urban	Rural	Units	Reference and comments
Proposed NextNav base station transmit characteristics (918-928MHz)						
1	NN poposed power limit in erp		1000	2000	W/MHz erp	NextNav Jun2024 proposed rules page A-10 for antenna height <1000ft
2	Power limit in dBm		60.0	63.0	dBm/MHz erp	Power in dBm=10log(Power in W)+30
3	Peak power above average	6.0	66.0	69.0	dBm/MHz erp	Broadband systems (see FCC §27.1507 and §27.50) define ERP as average and allow 13dB Peak-average; only 6dB peak to average used
4	Peak power in eirp	2.2	68.2	71.2	dBm/MHz eirp	Power in dBm eirp = Power in dBm erp + 2.2dB
Deployed RAIN reader receiver characteristics (typical values, not most susceptible values)						
5	RAIN reader input signal		-70	-70	dBm/MHz	Typical (not most susceptible) received signal into reader receiver
6	RAIN reader S/I requirement	10.0	-80.0	-80.0	dBm/MHz	Interference needs to be 10dB below desired signal
7	RAIN reader antenna gain	4.0	-84.0	-84.0	dBm/MHz rip	RAIN reader antennas vary with 0-9dB gain
Proposed NextNav base station transmit inteference into deployed RAIN reader receiver (not worst case)						
8	Path loss for inteference-free operation		152.2	155.2	dB	Minimum path loss for interference-free operation equals item 4 minus item 7
9	<i>Obstructed (e.g. dense buildings) separation distrance for interference-free operation</i>		11.7	14.6	km	HATA model, 923MHz, 100m base antenna height, 2m reader antenna height (e.g. https://www.rfwireless-world.com/calculators/Hata-model-path-loss-calculator.html)

Notes: As per FCC §15.247, RAIN reader frequency hops over 902-928MHz (26MHz band) within a 10 second period
 Above preliminary analysis is RAIN operation in 918-928MHz ("co-band") with NextNav, which occurs for 38% (10MHz/26MHz) of the time
 Other analysis for RAIN in 907-918MHz ("adjacent band") with NextNav, which occurs 42% (=11MH/26MHz) of the time, is not included
 Other analysis for RAIN in 902-907MHz ("co-band") with NextNav, which occurs 19% (=5MHz/26MHz) of the time, is not included

RAIN Reader to NextNav Mobile interference analysis

Item	Description	Adjust Factor (dB)	Value	Units	Reference and comments
RAIN reader transmit characteristics					
1	Part 15.247 conducted power limit		1	W	As per FCC §15.247
2	Power limit in dBm		30.0	dBm	Power in dBm=10log(Power in W)+30
3	Antenna gain	6.0	36.0	dBm eirp	As per FCC §15.247
NextNav mobile receiver characteristics (not most susceptible)					
4	NextNav mobile receiver		-95	dBm	3GPP TS 38.101-1 version 15.2.0 Release 15 as in reference 89 on page 28 of NextNav Petition (https://www.etsi.org/deliver/etsi_ts/138100_138199/13810101/15.02.00_60/ts_13810101v150200p.pdf)
5	Signal/Interference requirement	10.0	-105.0	dBm	Interference needs to be 10dB below desired signal
6	NextNav mobile antenna gain	0.0	-105.0	dBm rip	
RAIN reader (e.g. one deployed Part 15 device) transmit interference into proposed NextNav mobile receiver					
7	Path loss for interference-free operation		141.0	dB	Minimum path loss for interference-free operation equals item 3 minus item 6
8	<i>Obstructed (e.g. dense buildings) separation distance for interference-free operation</i>		<i>1.0</i>	<i>km</i>	HATA model, 923MHz, 2m mobile antenna height, 2m reader antenna height * (e.g. https://www.rfwireless-world.com/calculators/Hata-model-path-loss-calculator.html)

Notes: As per FCC §15.247, RAIN reader frequency hops over 902-928MHz (26MHz band) within a 10 second period
 Above preliminary analysis is RAIN operation in 918-928MHz ("co-band") with NextNav, which occurs for 38% (10MHz/26MHz) of the time
 Other analysis for RAIN in 907-918MHz ("adjacent band") with NextNav, which occurs 42% (=11MHz/26MHz) of the time, is not included
 Other analysis for RAIN in 902-907MHz ("co-band") with NextNav, which occurs 19% (=5MHz/26MHz) of the time, is not included
 * HATA propagation model has limitations for both antennas at 2m height; separation distance maybe further
 Above preliminary analysis is for one RAIN reader; multiple co-located readers will increase separation distance